

21-23 June 2005, at US Military Academy, West Point, NY

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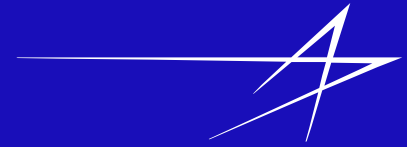
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Shipboard Organic UAV Operations

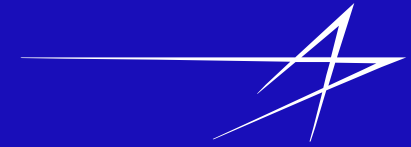
Presented to Military Operations Research Society Symposium



21-23 June 2005

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Balancing Risk for an Uncertain Future

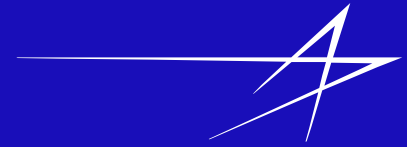


Topics

1 Background	<ul style="list-style-type: none">• Littoral Initiatives in Fleet Battle Experiment Juliet• Industry Led Collaborative Execution
2 UAV Integration	<ul style="list-style-type: none">• Evolution of Shipboard Organic UAV Concepts• Organic UAV Development Initiatives• Shipboard Implementation
3 UAV Ops Results	<ul style="list-style-type: none">• Shipboard Operation• Conclusions / Recommendations



1. FBE-J Experiment Background



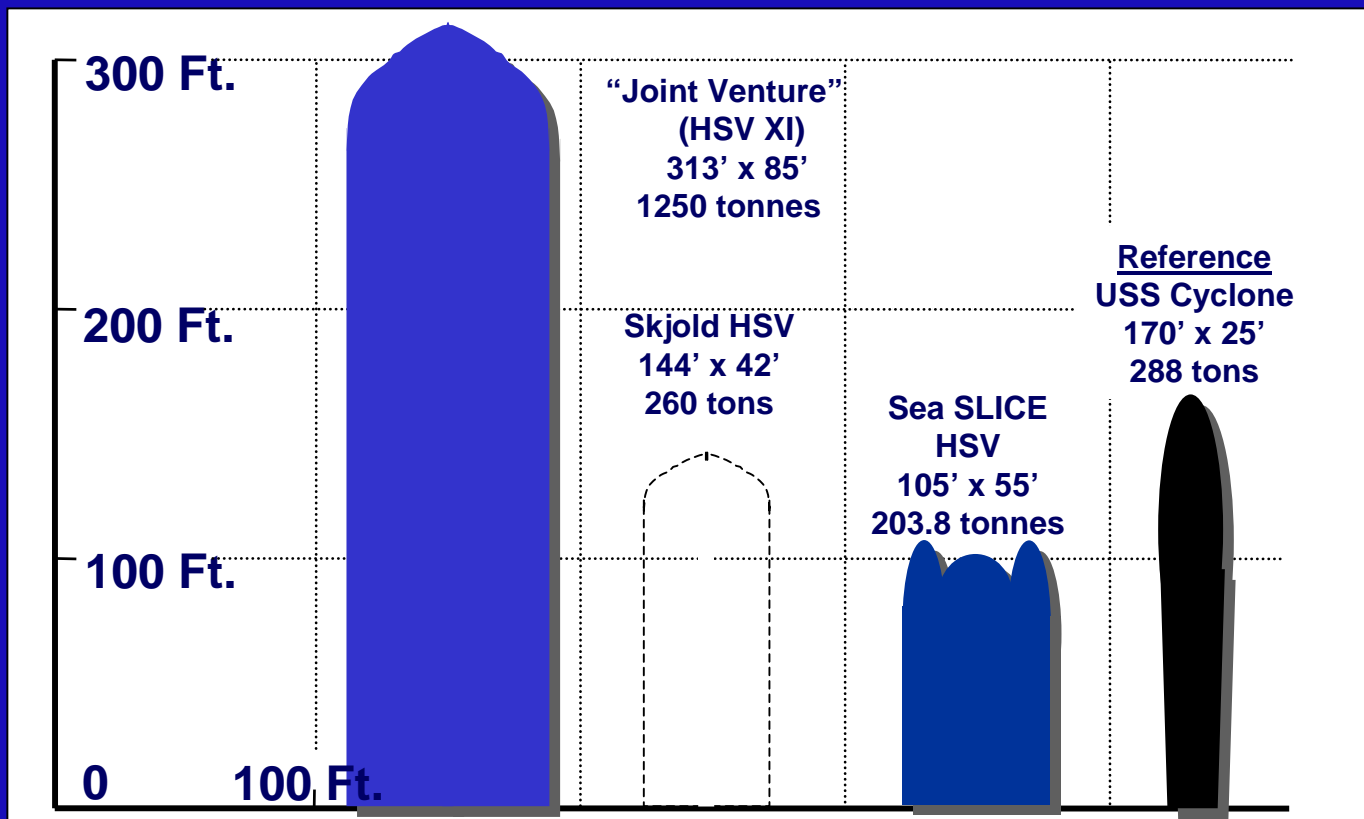
- **Navy Littoral Initiatives Assigned (July-Aug 2002)**
 - **Demonstrate Reconfigurable Littoral Platform**
 - **Demonstrate Netfires CONOPS in the Littoral**
- **Led Industry Collaborative Development**
 - **Organize as Sea Slice Team**
 - **Start Littoral Design with a Clean Sheet**
 - **“Be a Littoral Combatant” was Prime Requirement**
 - **Derive All Other Requirements**

Origin: Experimentation Platform Sea Slice



Unique, Fast, Stable Platform with Fortuitous Proportions

FBE-J HSV Size Comparisons

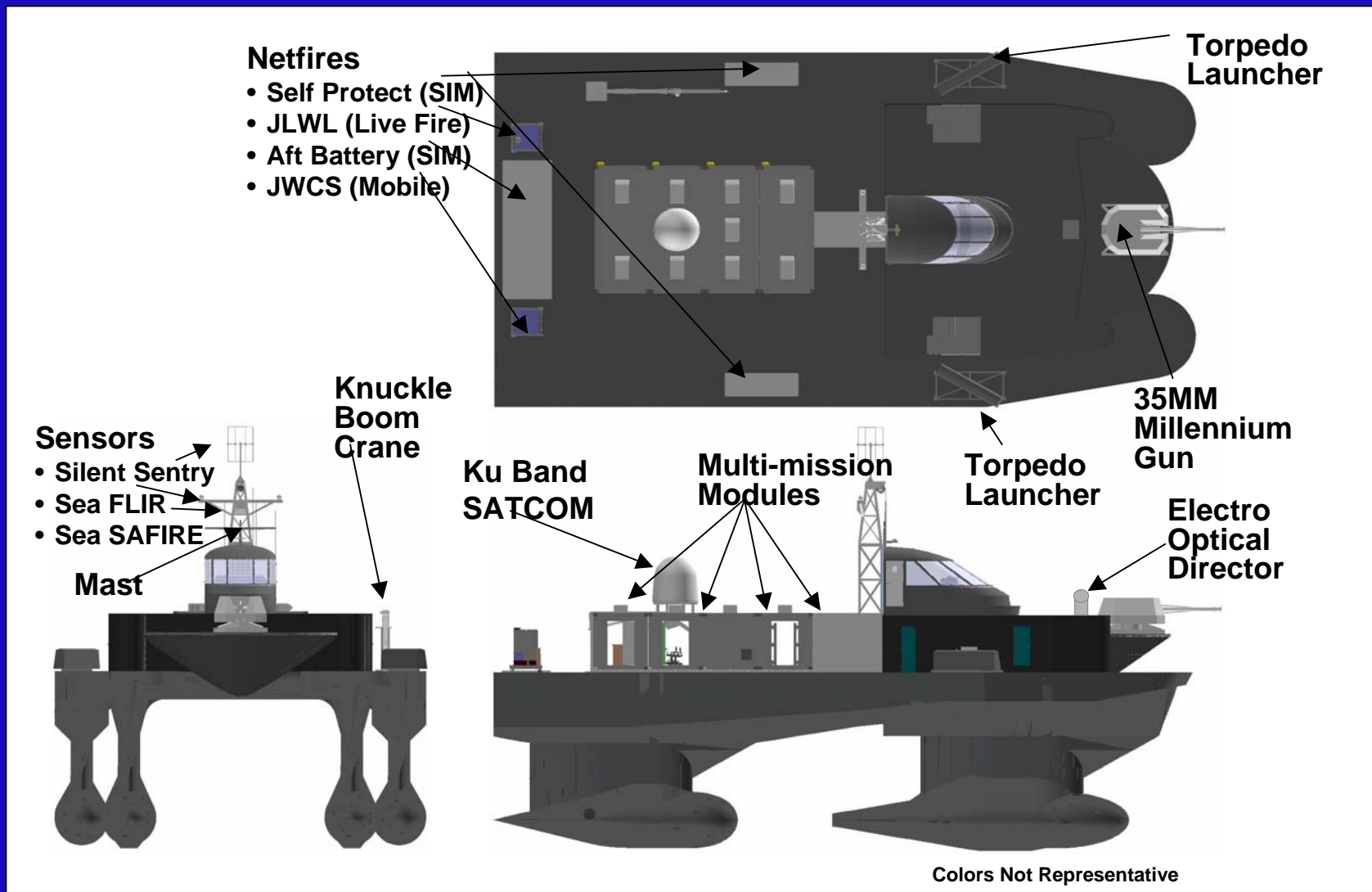


Sea SLICE Provides The Speed and Seakeeping Performance of a Ship 3-5x times its Size

Integrated Experimental Platform



Final FBE-J Sea SLICE Configuration

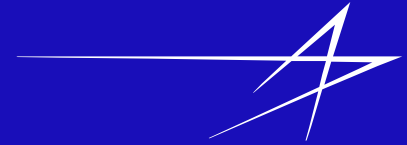


Driving Sea SLICE Concepts for FBE-J



- **Primary Experiment: Reconfigurability**
 - **Modular Mission Capability Implementation**
 - **Swap Out Equipment Every Few Days**
 - **Reenter Fray With New Mission Configuration**
- **Netfires Man-in-the-Loop Naval CONOPS**
- **Front Line “Node” Enabling Net-Centric Warfare**
- **Sea SLICE Multi-mission Modules**
 - **Command & Control (Supports all other modules)**
 - **Netfires (390 Simulated Rounds + One Live Firing)**
 - **Torpedo Launchers (Simulated 4 Rounds)**
 - **35 MM Gun Module (Simulated + Live Fire)**
 - **Passive Sensor Suite (3 FLIRs, Passive Radar)**
 - **Special Missions**
 - **Unmanned Underwater Vehicle**
 - **Towed Mapping Sonar**
 - **SOF Support (VBSS)**

Modular Mission Payload



- **Tasking**
 - **Equipment Mounting, Transport, and Positioning**
 - **Rapid Sea SLICE Reconfiguration**
 - **Support for Naval Fires and Mine Warfare**
- **Accomplishments**
 - **Performed Multiple Concurrent Tasks**
 - **Combined Self Protection Modules and Mission Modules**
- **Lessons Learned**
 - **Human Factors Investigation/Improvements Required**
 - **Strong Support for Side Scan Sonar Module**
 - **Gun Module Performed Well**
 - **Vert Rep Worked Well for STOM Support**



Vision for Collaborative Execution



**Collaboration of
Industry with Navy**

**Cost Effective
Operation**

**Industry Resources
and Support**



**Communications
Suite**

**Concept Development
and Validation**

**US Navy Venues
and Scenarios**

Industry Sea Trial Initiative

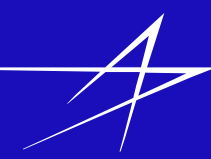
Method for Collaborative Execution



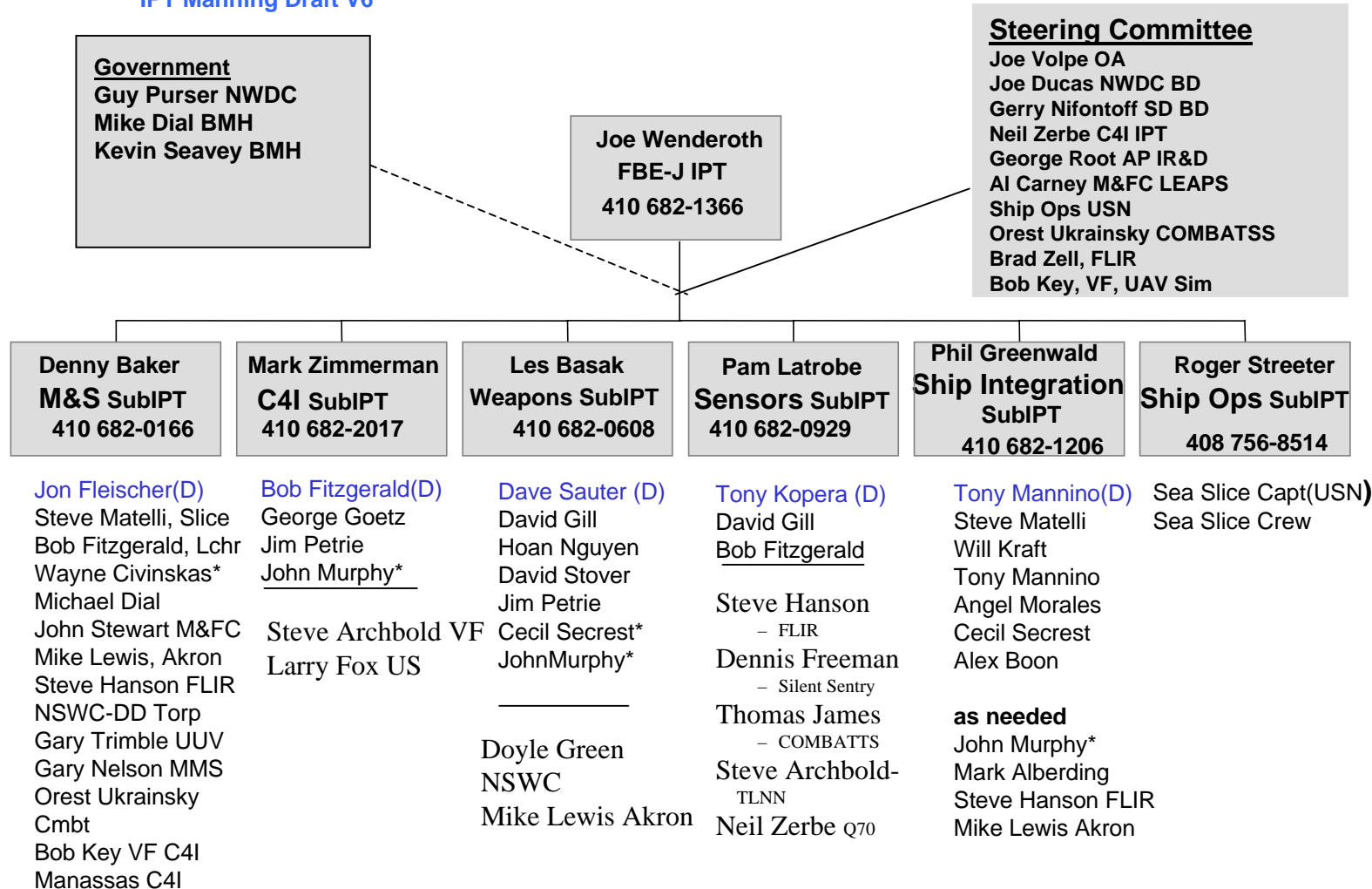
- **Form IPT and SubIPTs to Execute Integration & Test**
- **Manage Team at the Platform Level**
- **Invite Technology Collaborators and Vet Their Products**
- **Select Fielded Technologies (Intermediate Development Level)**
- **Form Advisory Group – Control Team Expectations**
- **Satisfy Navy Experiment Initiative Requirements, but...**
- **Start with Clean Sheet - “Be a Littoral Combatant”**
- **Allow for Overlapping Capabilities (Redundancy)**
- **Develop Agreements among Partners (Terms of Reference)**

Team Building is a Social Process

Sea Slice Team FBE-J IPT Partners

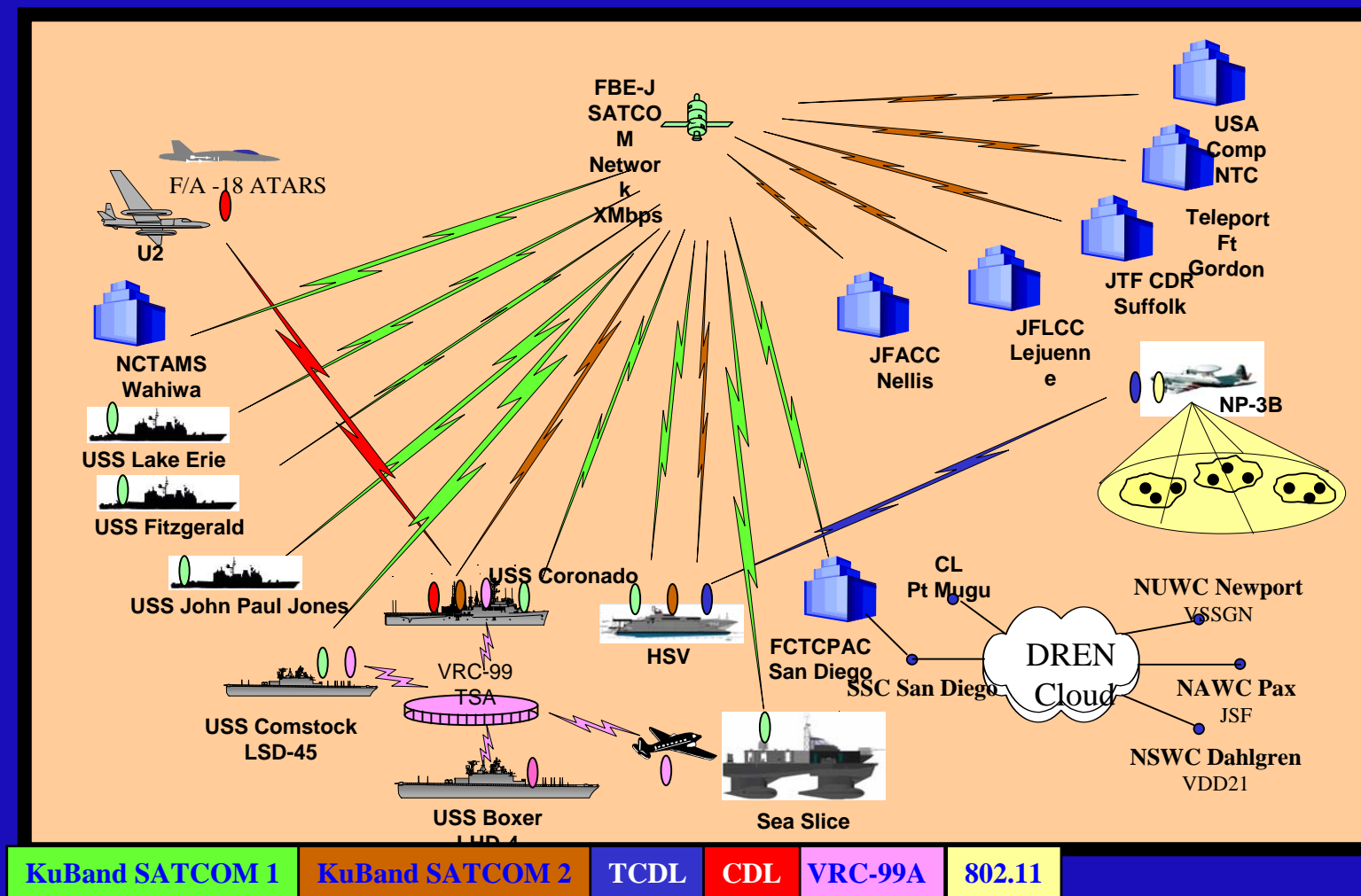


IPT Manning Draft V6



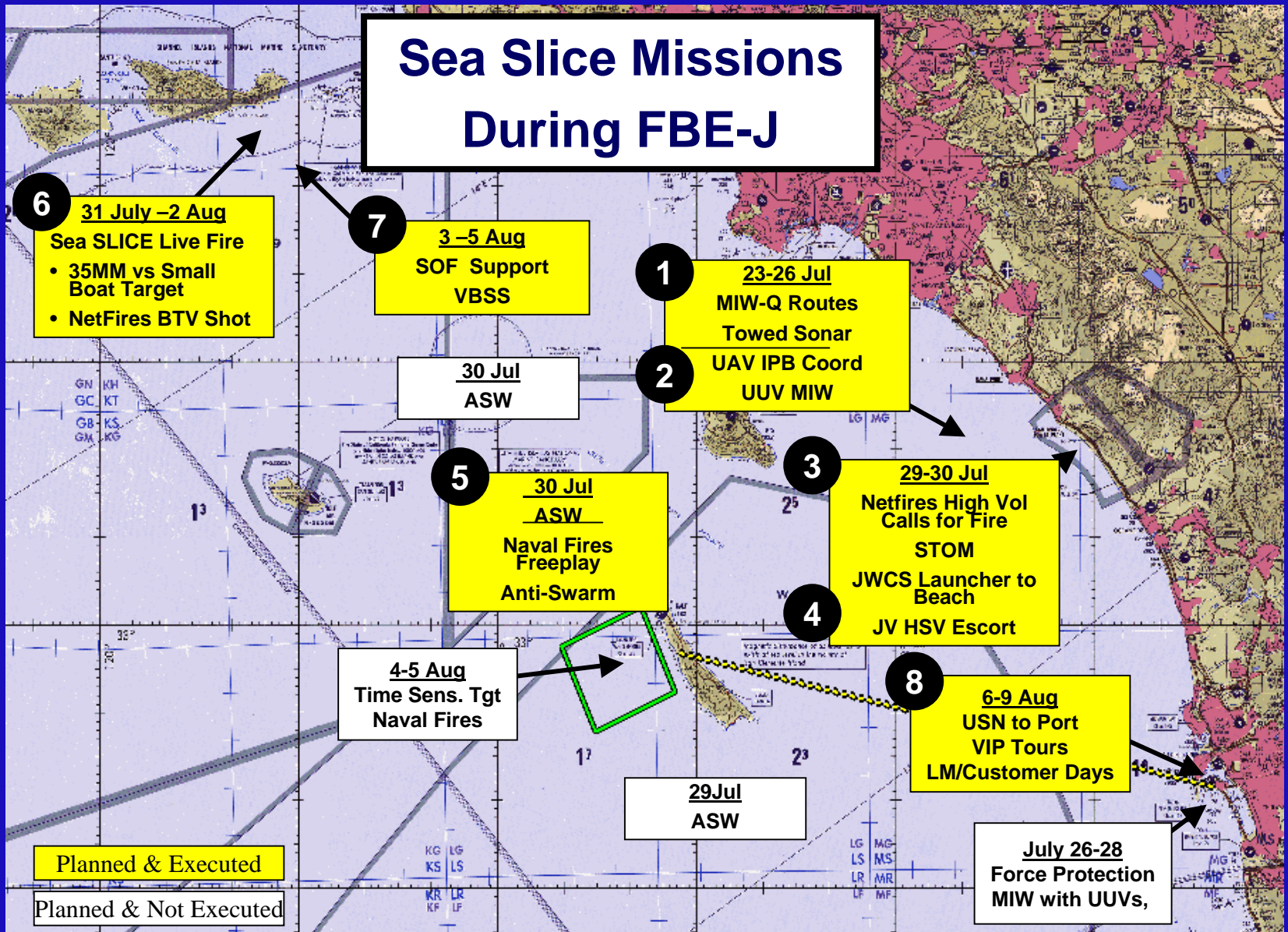
Lots of Players → Complex Communications

FBE-J Communications Architecture



NWDC Slide (with LM mods)

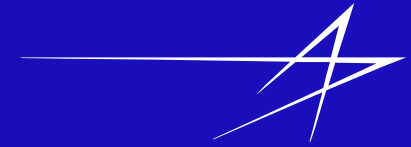
Sea Slice Missions During FBE-J



Challenging Schedule Provides Many Opportunities



“Our” FBE J Conclusions / Recommendations



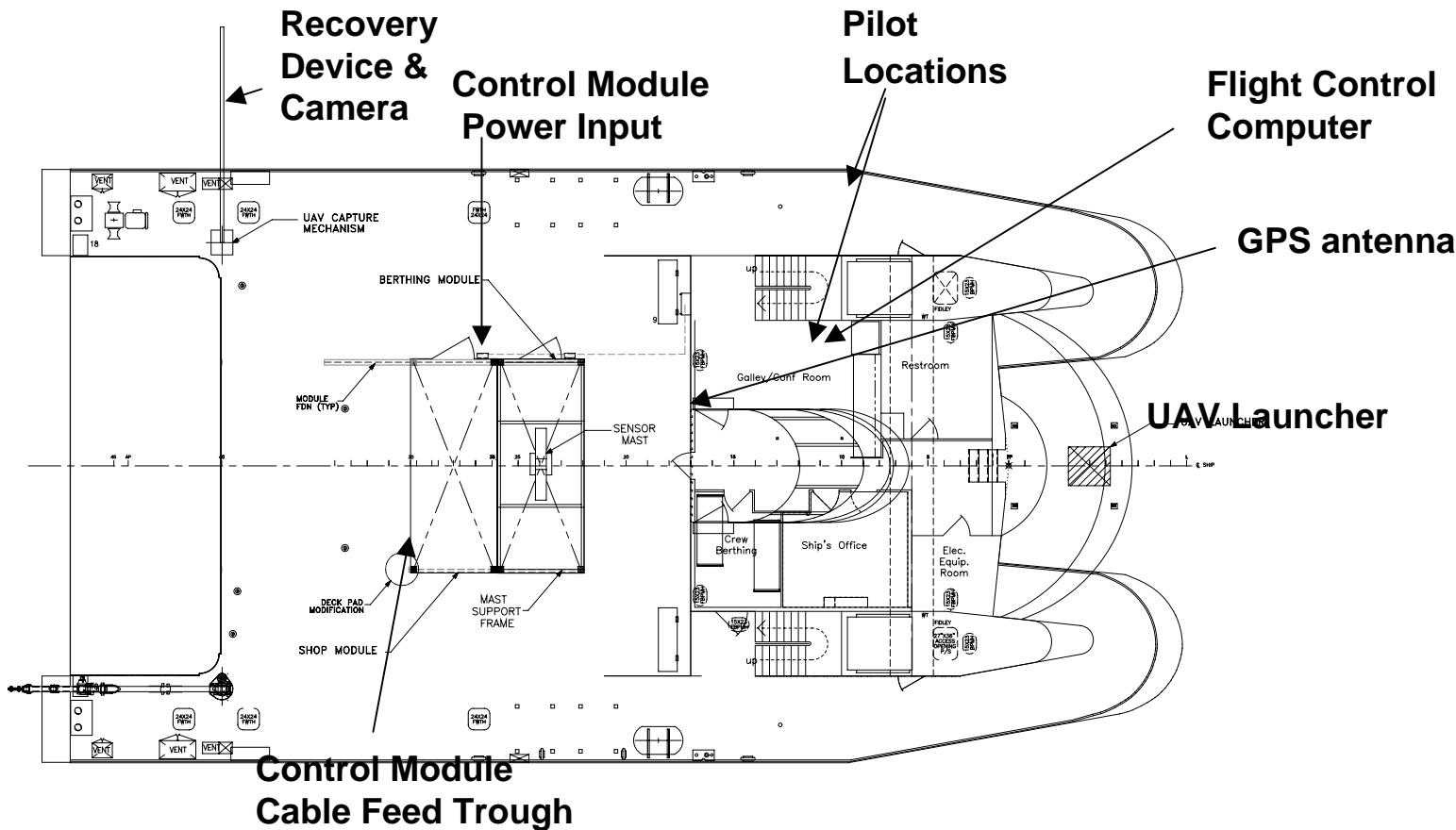
- **FBE J Proved Utility of Focused Mission Modules**
 - **Spawned Focused Mission Ship and LCS Solicitations**
 - **Rapid Reconfigurability Can Be Achieved**
- **Coordinated Small Boat Attacks are a Major Threat**
 - **Need a Surface-to-Surface Weapon with Standoff Range**
 - **Must Rapidly Find, Identify, and Attack Fast Attack Craft**
- **Anti-Small Boat System Requires:**
 - **Persistent Surveillance with Organic Off Board Platform**
 - **UAV Mission Module Integrated with Weapon System**
 - **Generic Components (Launch, Control, Capture)**

2. UAV Mission Module Integration

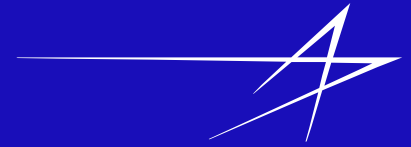


- **Evolution of Shipboard Organic UAV Concepts**
 - **Use Systems Orientation with Shipboard Demonstration**
 - **Enable Weapons Engagement with UAV Technology**
- **Organic UAV Development Initiatives**
 - **Design for Minimal Manning**
 - **Strive for Routine, Persistent UAV Operations**
- **Shipboard Implementation**
 - **ONR Demonstration Funding via Small Business (STTR)**
 - **Develop Generic Components (Launch, Control, Capture)**
 - **Define Mission Specialist Roles and Procedures**

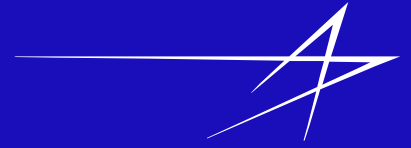
Sea Slice UAV Ops Demo Arrangements



Demo Shelters & Mission Mast



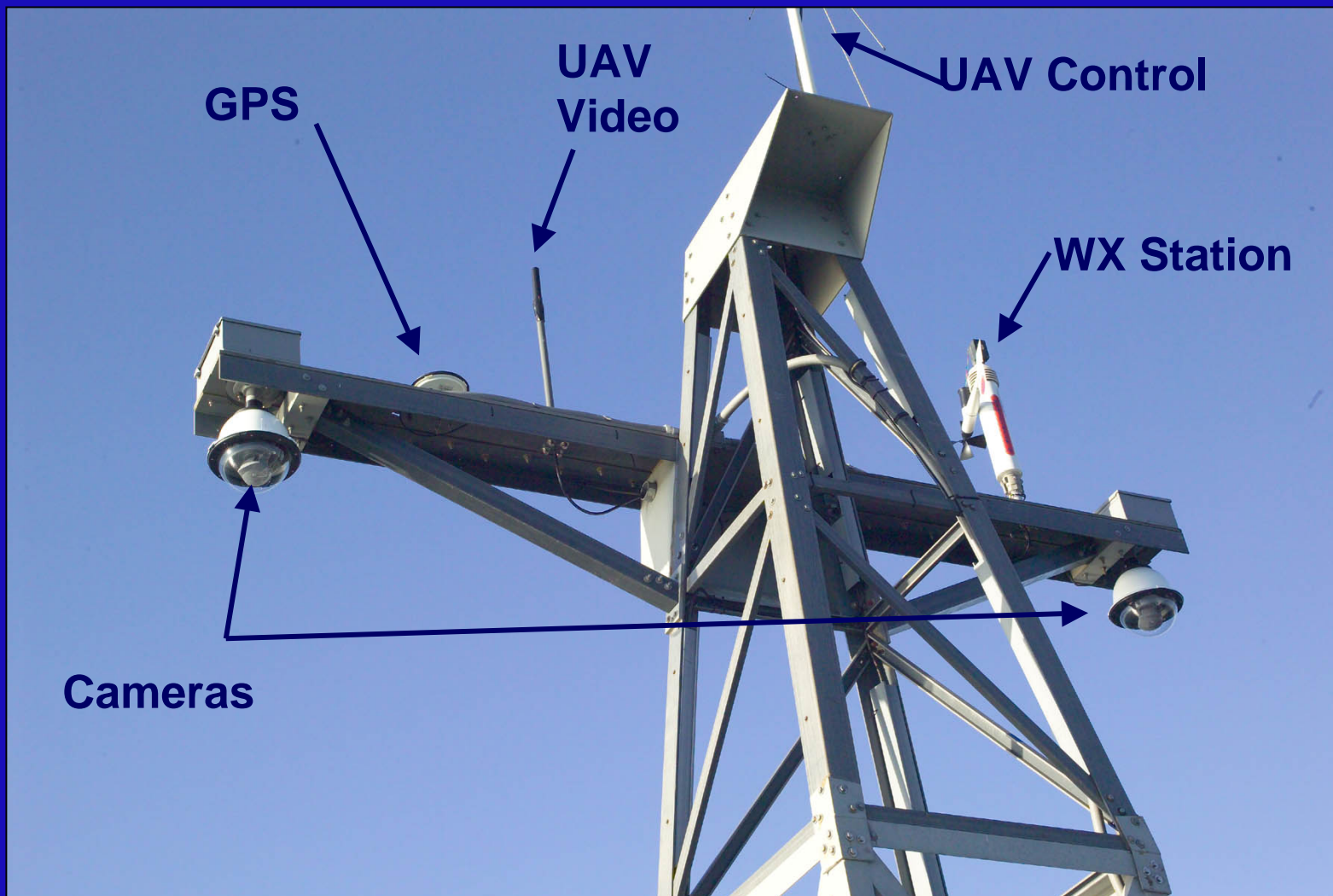
Shelter Loading On Sea Slice



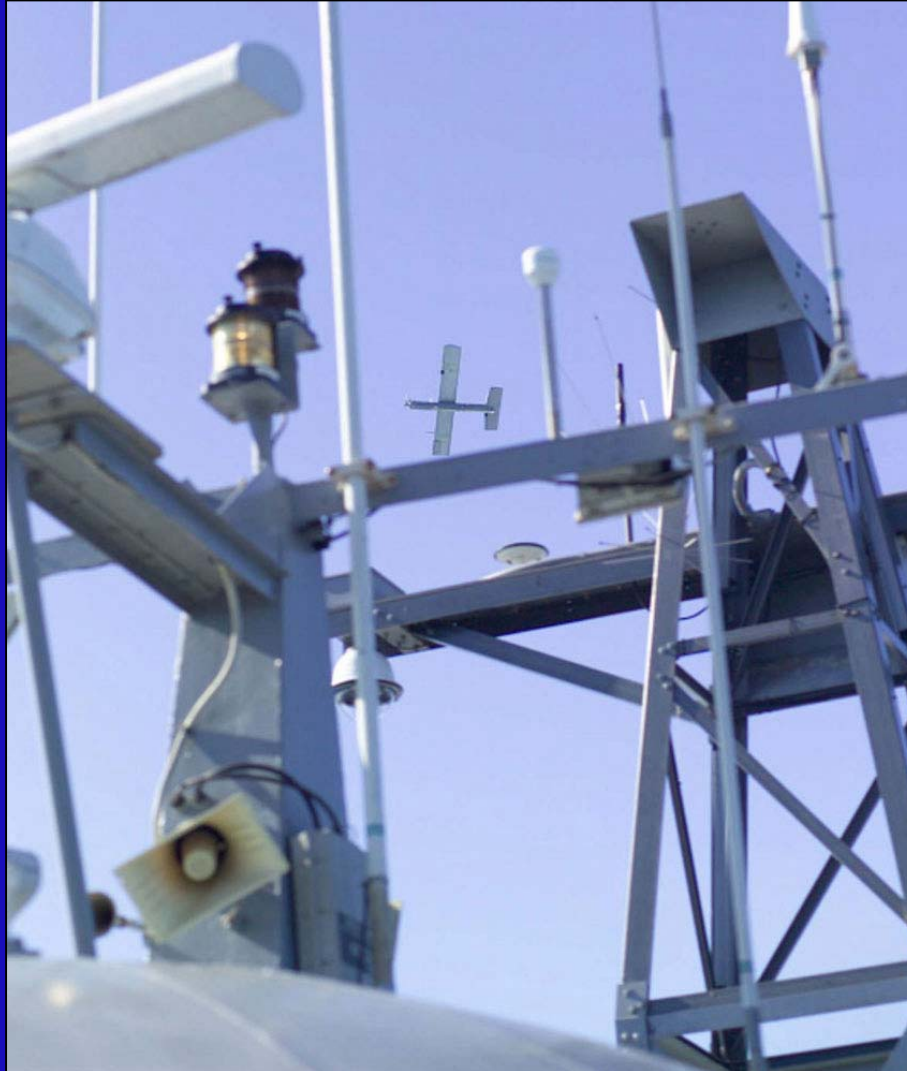
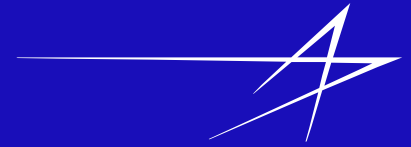
Shelter Universal ISO Mounts



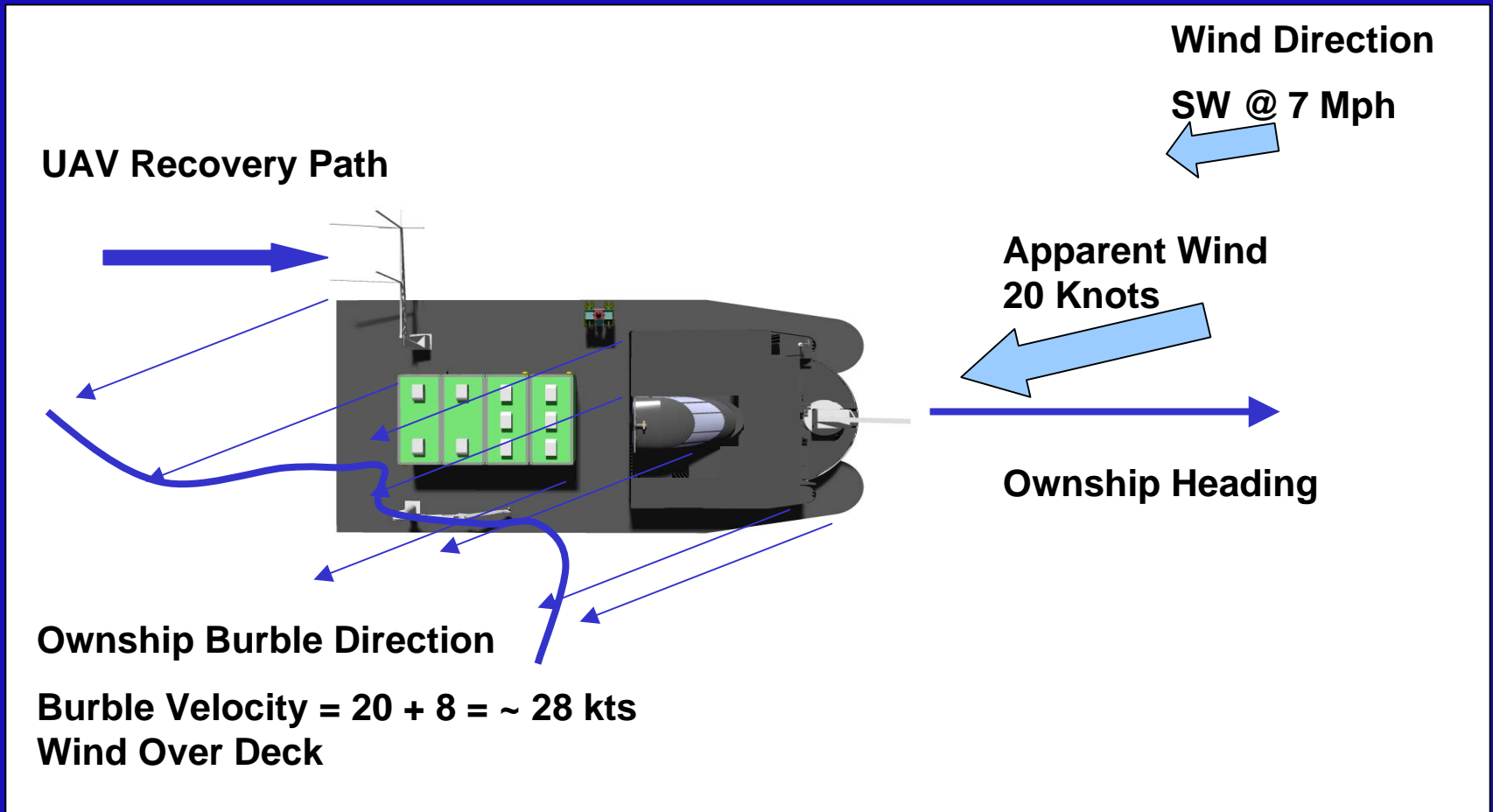
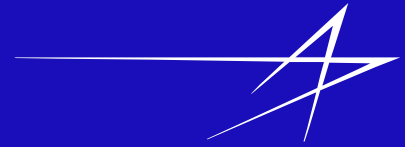
Mission Mast as Installed



Complex EMI/EMC Environment



Ownship Heading Plan for UAV Recovery

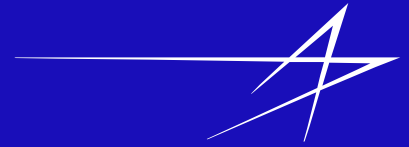


Consider Wind Over the Deck

ANLAS / GUSS / Valiant Control Station

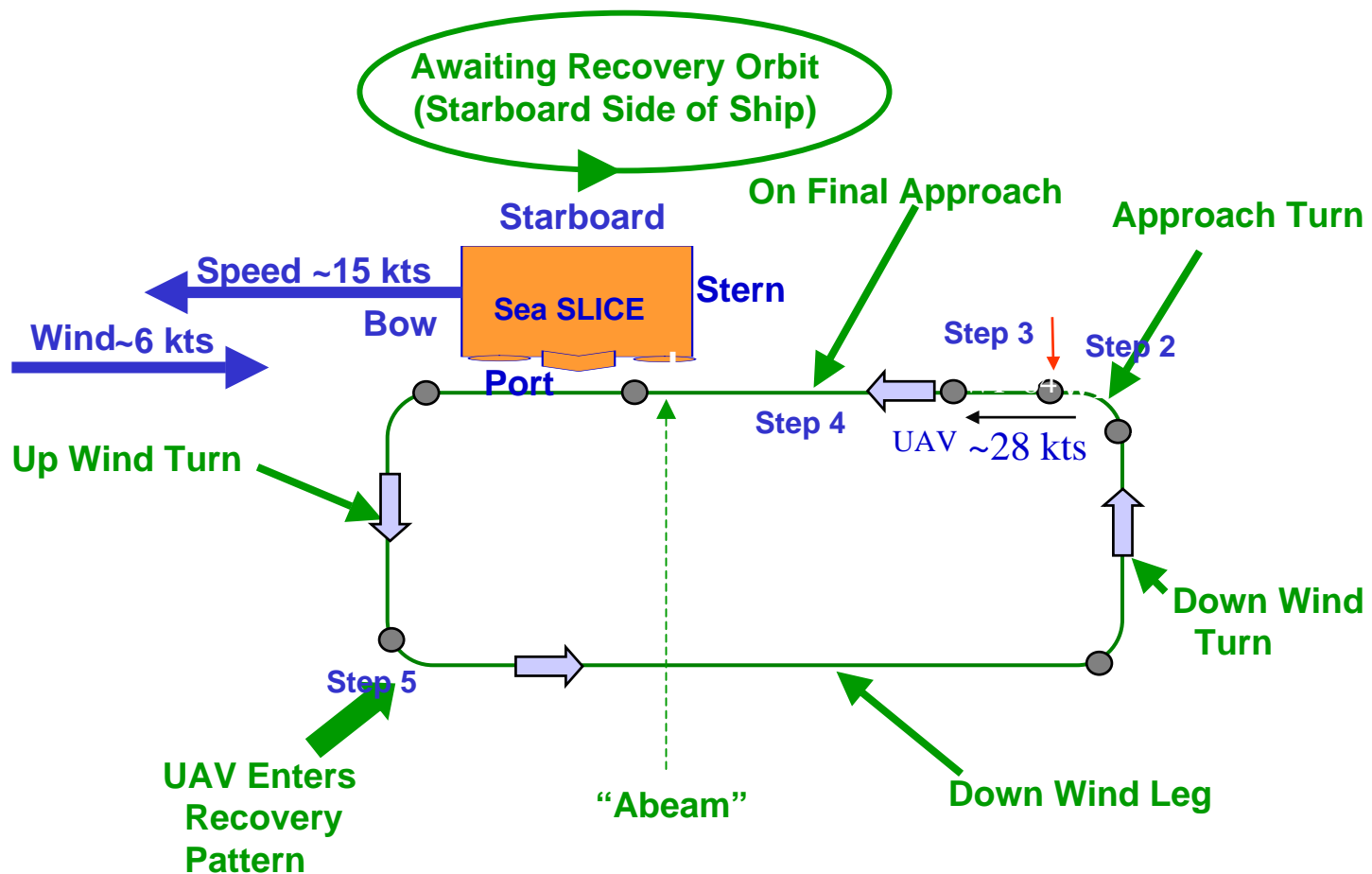


Pilot with Manual Control

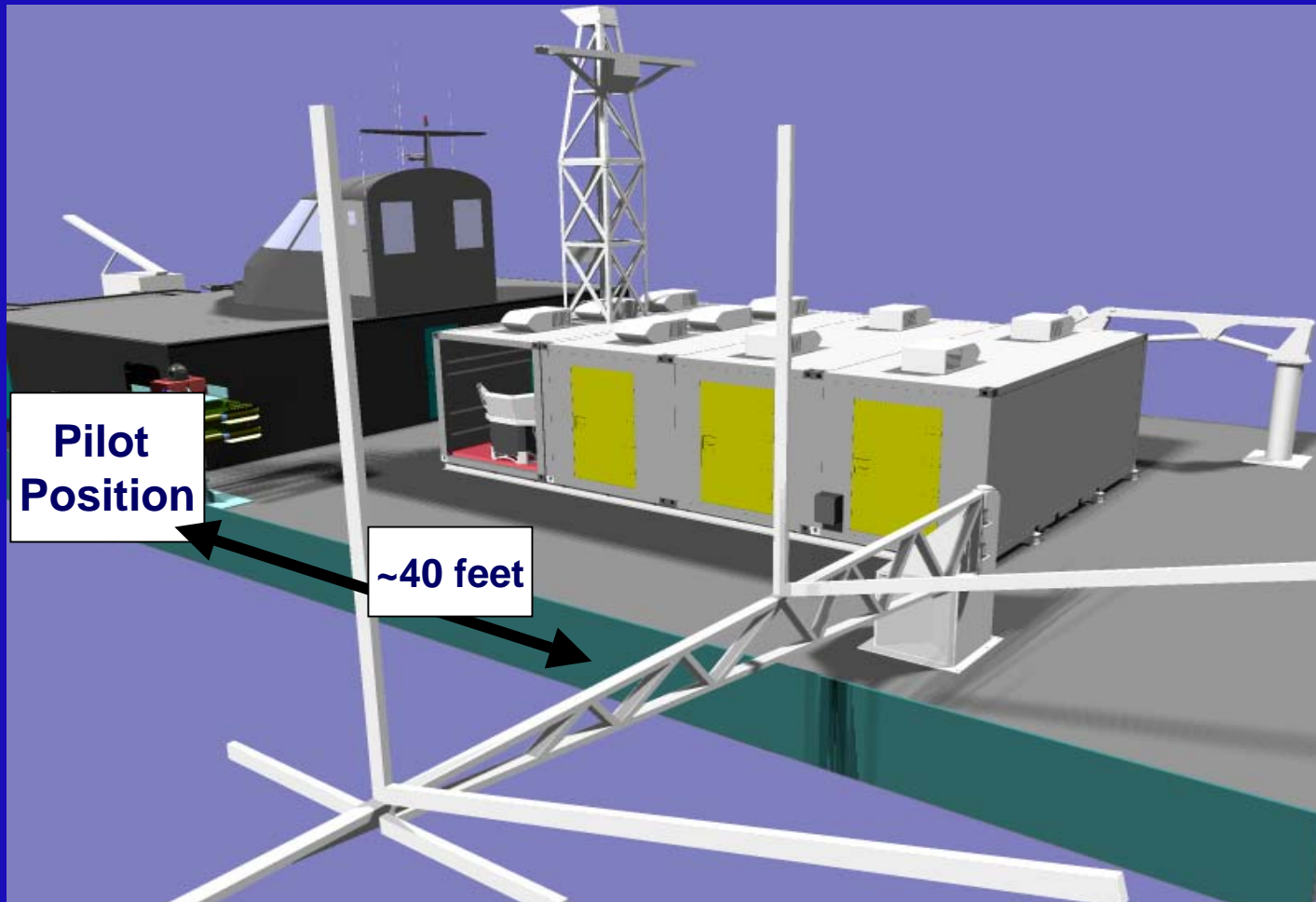
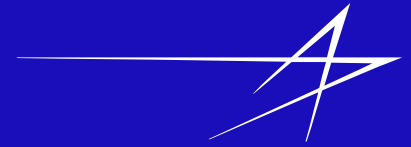


Demonstrate Automation Needs

UAV Recovery Operations At-Sea

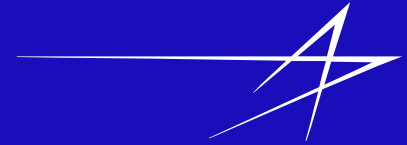


Pilot View Point: Net or Arresting Line Capture



Pre-Launch Checks





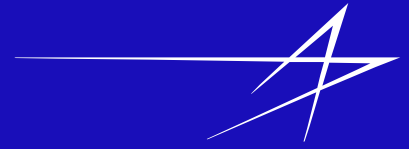
3. UAV Ops Results

- **Shipboard Operation**
 - **Launch Methods**
 - **Manual and Automated Control**
 - **Recovery Sequence**
- **Conclusions / Recommendations**
 - **Shipboard Impact**
 - **Mission Module Evaluation**
 - **UAV Operations**

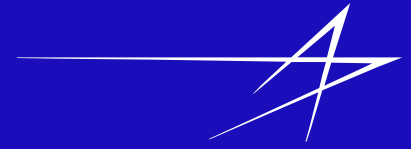
Silver Fox Launch from Sea Slice



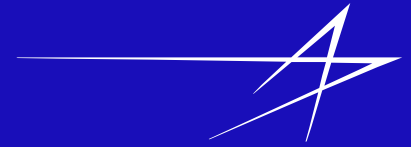
Recovery System Stowed



Deploying Recovery System

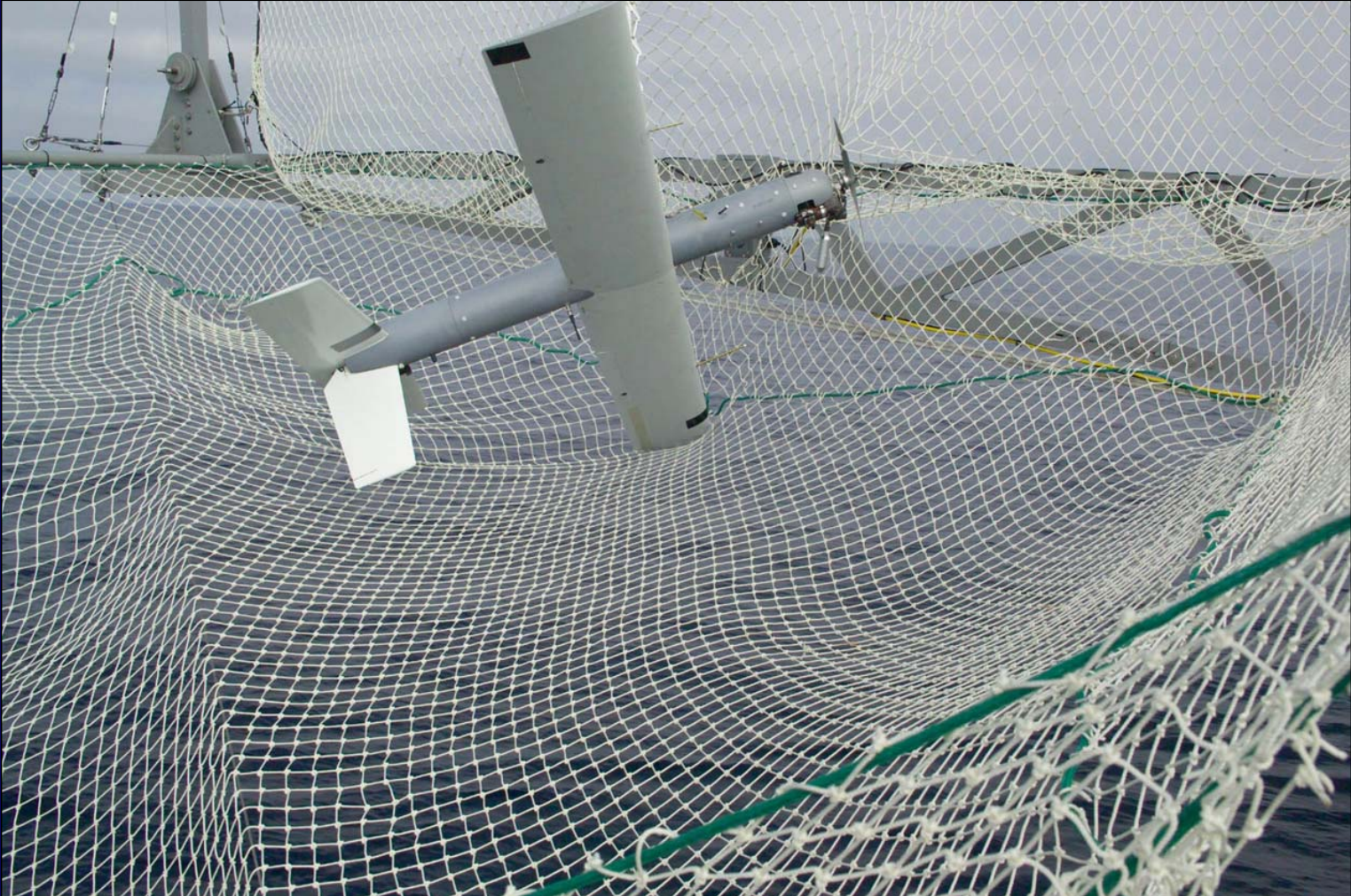
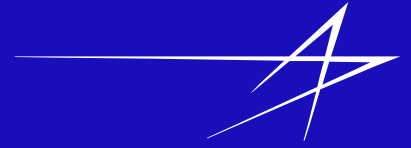


Net Recovery of Silver Fox

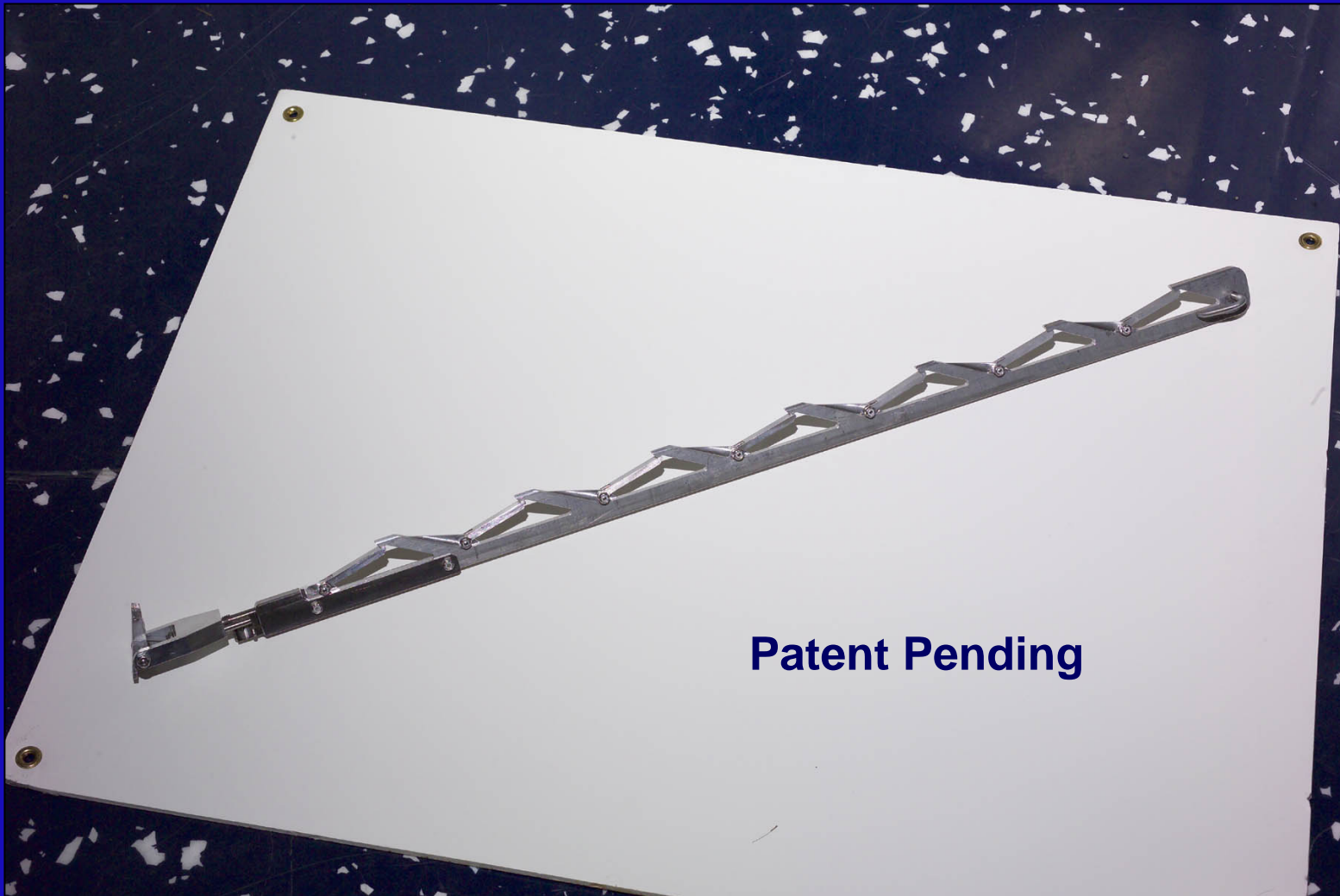


Patent Pending

Recovered Sliver Fox

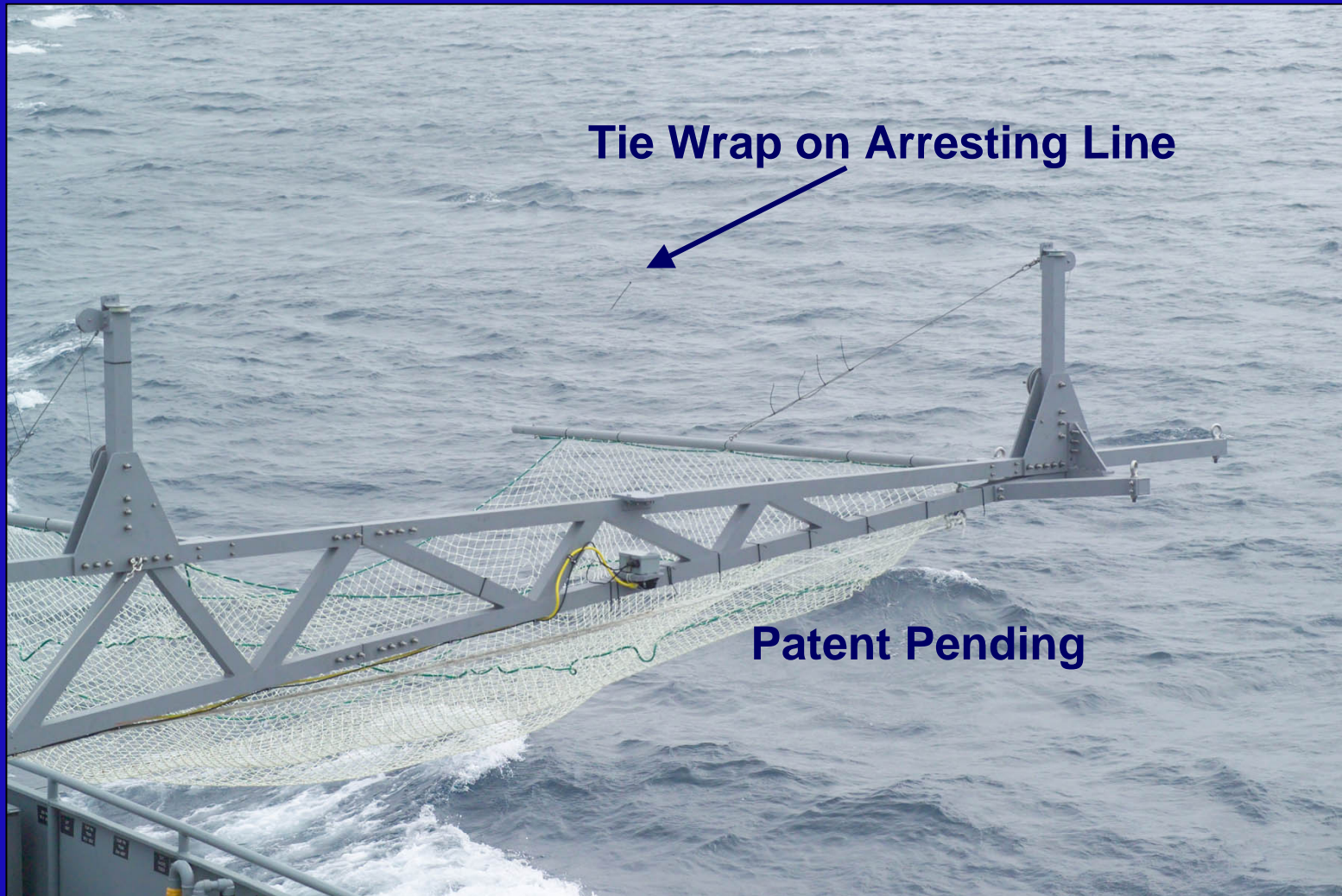


A-SULCRS Developed Tail Hook

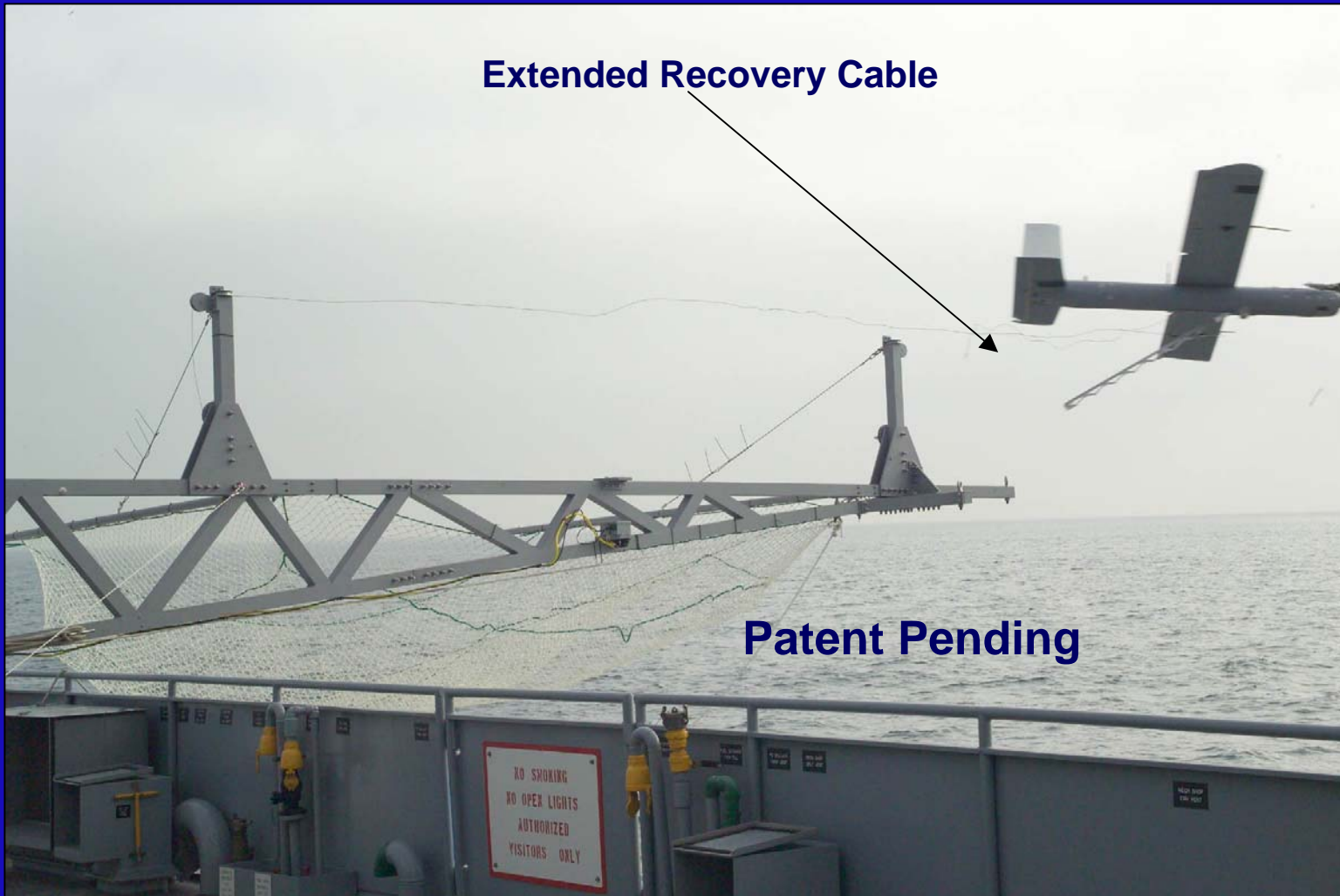


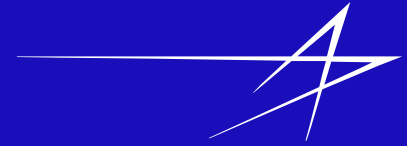
Patent Pending

Arresting Line Configuration



Initial Arresting Line Engagement

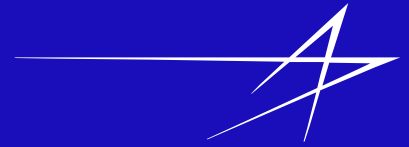




Demonstration Summary

- **Launch:**
 - 8 of 8 Successful UAV Pneumatic Launches with Tail Hook
 - Hand Launch and Bungee Launches are also Possible
- **Control**
 - Remote Operational Control (Mission Control)
 - Drop Hook Executed Reliably
 - Flight Plan Transmit Verified
 - Glide Slope Control
 - Generally Good for Positioning UAV for Recovery
 - Auto Recovery Control
 - Requires Improved UAV Flight Control Accuracy for Success
- **Recovery**
 - Net Recoveries
 - Promising, Especially with Tail Hook Net Capture
 - Comments: UAVs Design Tradeoff for Maritime Recovery Operation
 - Arresting Line Recoveries
 - Requires More Testing for Characterization
 - Comments: Tail Hook and Latch Design Looks Promising

Sea SLICE Underway



Questions?